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TEXT.

UNIT TA 4.

SUBJECT:

PIPE WORK.

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WHEN THE STUDENT HAS QUALIFIED ON THE LESSON.

International

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Before the change in the method of handling the Bureau work we used some of these lessons in our courses and until we can issue our own new lessons we will have to continue to use a few of these outside publications.

When you finish with the study of this lesson and have had your answers graded and returned we would appreciate your returning this pamphlet to us for the use of other students, as we have but a limited number of these lesson papers on hand.

Your record will be so kept that when we issue our own lesson paper on this subject, you will receive a copy free of charge.

D. C. BUELL.

ADVICE TO THE STUDENT

Study a few pages at a time—do not skip from one section of the Paper to another. If examples are given in the text, compare the solutions carefully with the rules, formulas, or other text matter relating to them. If there are EXAMPLES FOR PRACTICE, some or all may be worked, also; but this work need not be sent to the Schools for correction. If you meet with any difficulty, write us for help—using the "Information Blank." If there are any statements you do not understand, let us know, and we will explain them in detail. Pay particular attention to the definitions; a correct understanding of them is essential.

Review the entire subject; then write out your answers to the Examination Questions at the end of this Paper, and send your work to us for examination and correction. Your answers should occur in the same order as the questions are printed. Do not write out the questions—merely write their numbers. If you are unable to answer some question, write us, on an Information Blank, for assistance.

If you need **help in your studies**, ask for it. If necessary, we will assign to you a Special Instructor, who will give you personal attention and assist you in mastering the subject. It is our aim to come into as close touch with our students as possible, and we therefore request you to keep us informed at all times regarding your progress and any difficulties you may meet with in your studies.

INTERNATIONAL CORRESPONDENCE SCHOOLS

PIPEWORK

IRON PIPEWORK

CAST-IRON PIPEWORK

23908

CUTTING SOIL PIPE

1. Standard cast-iron soil pipe may be cut by first filing a groove around it and then deepening the groove with a cold chisel. If the filing of the groove is omitted, and an attempt made to cut the pipe by using only a hammer and cold chisel, there is a strong probability that the standard pipe will be split. When a soil pipe is to be cut to fit, a length of double-hub pipe should be selected in preference to single-hub pipe, since with double-hub pipe the end not desired may be used on some other job.

2. Extra-heavy soil pipe can be cut with the hammer and chisel. To cut it, draw a line neatly around the pipe at the place where it is to be cut. Lay the pipe on a solid block of wood or on a mound of earth, and, following the chalk line, cut into the pipe with a hammer and chisel, as shown in Fig. 1. A groove is thus made all around the pipe, which weakens it. Continue driving the chisel into the

groove uniformly all around, revolving the pipe with the knee, as shown. In a short time the metal under the groove

Fig. 1

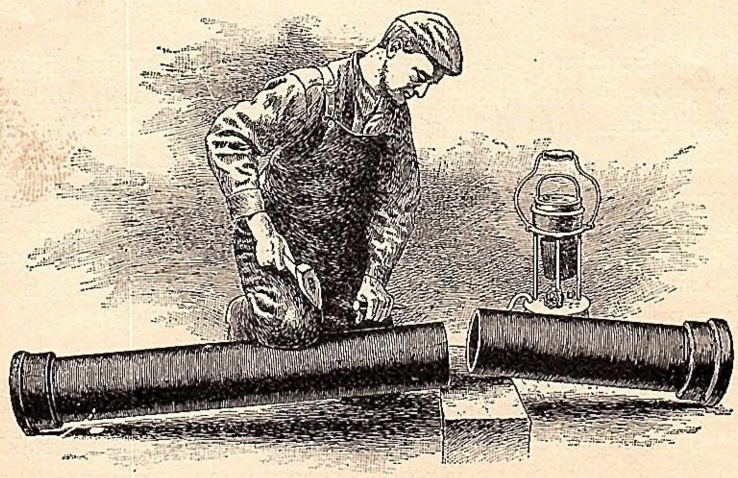

Fig. 2

will be so ruptured that the piece will fall off, as shown in Fig. 2, making a neat square cut.

3. It sometimes happens that a pipe is defective and will not cut square, breaking crooked, as shown in Fig. 3. Such a piece should not be used, but may be cut again when a shorter piece is required. Or, if circumstances permit the pipe to be shortened, say to the dotted line *a*, the end may be **chipped down,** as shown in Fig. 4. The piece of pipe is rested against the edge of an iron beam, or any other convenient hard edge, so that the line to which the end of the pipe is to be chipped comes on the edge. A piece is then broken off and the pipe revolved a little, when another piece is broken off. This operation is repeated until the

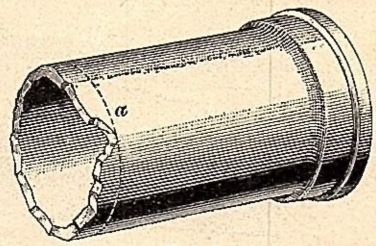

FIG. 3

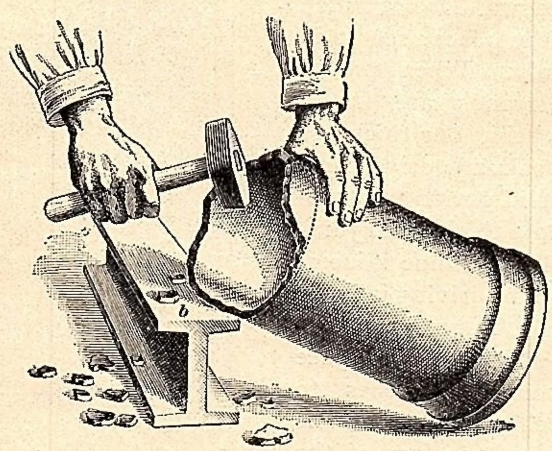

FIG. 4

end is square. The edge obtained by chipping is rough, but if well done, the irregularities need not be more than $\frac{1}{8}$ inch deep. A break like that shown in Fig. 3 is usually due to an unskilful manipulation of the tools; it does not necessarily indicate a defective pipe.

4. When a pipe splits, as shown in Fig. 5, while being cut, it usually proves that the pipe is defective; a pipe thus split should be rejected.

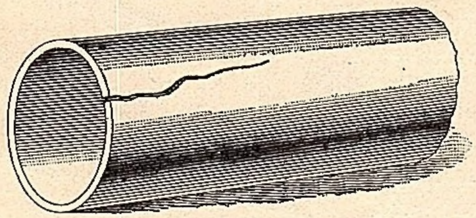

FIG. 5

CALKING JOINTS

5. Calking a Vertical Joint. To calk a spigot-and-socket joint in soil pipes, push the spigot end tightly into the socket; then, with the yarning tool, drive twisted oakum into the socket, as shown in Fig. 6. Do not cut the oakum with the edge of the tool; simply push it down. Do not bunch it at any place; set it in uniformly. When two or three strands are in (a strand being one thickness of the oakum), drive them down solidly with the hammer and a thick-faced yarning tool. Continue to insert the oakum, driving it home with the hammer periodically, until there is a space of about $1\frac{1}{4}$ inches to $1\frac{1}{2}$ inches between the oakum and the face of the socket. Then, to insure that the oakum is packed into a thoroughly compact mass, give it a final driving with heavy blows of the hammer on the yarning tool.

FIG. 6

6. After the oakum has been packed in, the space above it is filled with molten lead, as shown in Fig. 7, the face of

the hub being held perfectly level so that the lead will not overflow on one side before the other is entirely filled. A large enough ladle should be used to allow the joint to be made in one pouring. If the socket is only partly filled at one pouring, the lead will set before more can be obtained from the pot, and the result will be an imperfect joint. Only soft pig lead should be used for this work; hard lead as obtained from old wiped joints, or lead impregnated with impurities, should not be used.

FIG. 7

7. After the joint is **run up,** that is, filled with lead, take a thick-faced staving tool and drive the lead ring uniformly into the socket, as shown in Fig. 8. This compresses the lead and makes it fill the interstices of the socket so closely that the joints will be air- and water-tight, even if subjected to high pressure. If this staving is omitted or carelessly done, the joint may not

FIG. 8

be water-tight. It certainly will not be strong enough to resist the wear and tear of service.

8. If the oakum is not thoroughly packed and driven home with a yarning tool before the molten lead is poured into the socket, the lead will drive it too far when it is calked, and the work will be defective. In a joint of an upright pipe the lead should be poured into the socket until it stands about $\frac{1}{8}$ inch above the rim, when it is just on the verge of overflowing, as shown at *a* in Fig. 9. The object of the excess of lead is to obtain a flush finish with the edge of the hub when the lead is calked; this result obtains if the oakum has been packed in solid. The stiffness and durability of the joint depend on the perfect and complete filling of the socket to the extreme edge.

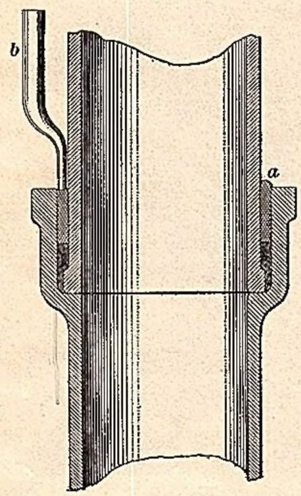

FIG. 9

9. The process of calking the lead or oakum should be begun at the most difficult or inaccessible parts of the joint, so that the lead and oakum in these parts will be compressed still more when the other parts of the joint are being calked. The staving tool or lead calking tool *b*, Fig. 9, should be run around gently the first time, and then around again with heavier blows of the hammer to drive the lead uniformly home, thus avoiding unequal strains on the socket. Each blow of the hammer increases the pressure inside of the hub, and judgment must be exercised to avoid cracking the hub by overpressure. It is well for the beginner to calk a few joints as an experiment until the sockets burst, to determine when he should stop calking.

The staving tool should not be tapered, because then it is liable to wedge between the hub and pipe, if the lead is below the edge of the hub, and strain the hub so that it will crack

when the calking of the lead is about completed. A cracked socket should always be removed and be replaced by a new pipe.

10. Calking a Horizontal Joint.—In making horizontal joints, or joints on inclined pipes, the outer end of the socket must be closed by a band or joint runner, as shown at *a*, in Fig. 10 (*a*). If a special joint runner is not at hand, the band is usually made of clay and strengthened by a piece of rope embedded in the clay. A **gate,** or pouring notch, is left at the top, and molten lead is poured into it from the ladle, as shown. The working face of the clay is

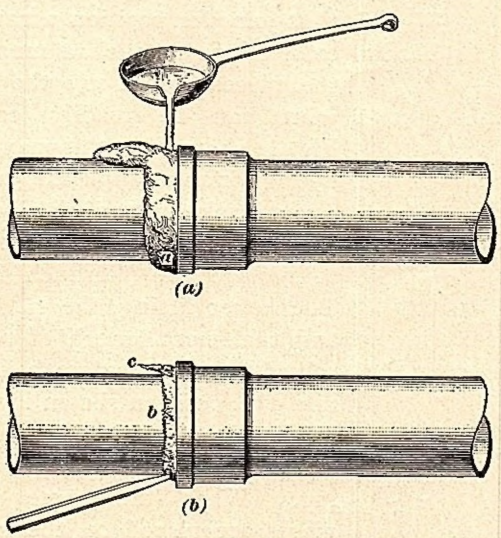

FIG. 10

shaped so that the lead will take the form shown in Fig. 10 (*b*) at *b*, the projection *c* being the gate. Pouring should not be stopped until the gate is full and remains so. Particular care should be taken before pouring that the socket be wholly free from moisture; otherwise, an explosion is very likely to occur while the lead is running in, by the moisture being suddenly converted into steam. To guard against this danger, the workman should always stand behind the

hub, so that if an explosion does occur, the hot lead will be projected away from him. If it is necessary to pour lead into a damp socket, some powdered rosin should first be thrown into the socket. This will help to prevent a violent explosion. The joint runner must be tightly secured, because the pressure of the melted lead in sockets of large diameter is considerable; if it starts the band a little, the lead is liable to run out and thus spoil the joint.

11. Calking Inverted Joints. — When a joint is inverted, it is advisable to do the calking before placing the pieces thus joined in position, arranging the connections in such a manner that the pieces joined by the inverted joint can be readily connected. Fig. 11 shows how this may be done, taking for an example the junction of a vent stack *A* with a soil-pipe stack *B*. The soil-pipe stack is erected ready to receive the Y-branch fitting *a*. The latter fitting, the 45° elbow *b*, and the short length of pipe *c* are calked together before being placed into the position shown in the illustration, as the joints between them can then be placed upright for calking. When the three combined pieces are placed on the soil stack and vent stack, their joints with these pipes are upright, and consequently easily calked.

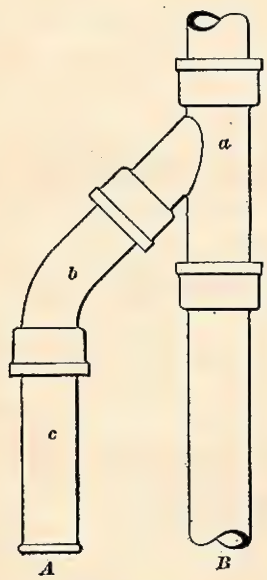

FIG. 11

12. It is inadvisable to try to calk an inverted joint in place unless special provision is made for air to escape from the socket, since otherwise an air lock will occur, as shown at *a* in Fig. 12. If the oakum *b* is calked solidly home, it will be practically air-tight. The air at *a*, therefore, cannot escape freely, and hence the lead will set before the space is filled. After the clay band *c* is removed, the lead is

calked, but it will be found that the lead at *d* cannot be driven up into *a* to fill the socket entirely at this place. This part of the joint will hence be defective.

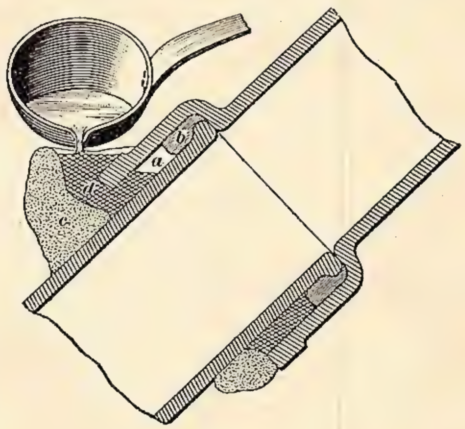

FIG. 12

13. If it is necessary to calk an inverted joint in place, a special fitting should be used that has a pouring gate cast on the socket, as shown at *a*, in Fig. 13. The air escapes through this pouring gate, as shown by the arrow, while the molten lead is running into the joint. This joint can be entirely filled with lead and pouring is stopped when the gate is entirely filled. After this joint is calked in the ordinary manner, the gate is also calked, and a solid job is thus obtained. Plumbers seldom have occasion to use inverted joints, however, because permission is generally granted in plumbing ordinances to connect vent pipes to stacks at right angles.

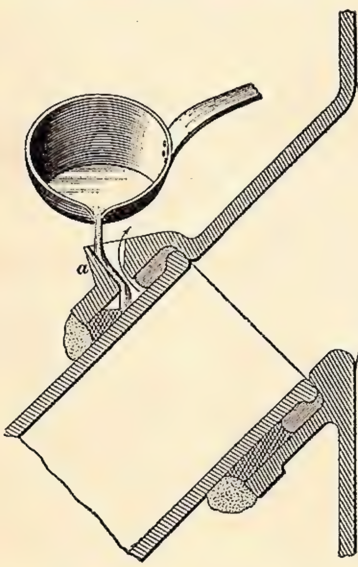

FIG. 13

14. Defective Calked Joints.—If a pipe having no spigot ring on the end is calked into a socket, there is a

liability of the oakum being driven into the pipe, which tends to catch solid matter in the sewage and thus finally choke the pipe. To guard against this, make a mark on the pipe flush with the socket when it is solidly home, and before calking in the oakum; then, after calking in the oakum examine the mark before running the joint with lead to see that the pipe has not slipped out. This is most liable to occur when calking horizontal joints on the floor. Another defective joint is that in which a poorly cut pipe like that shown in Fig. 3 is used. The oakum is then driven through the irregularities, as shown in Fig. 14. This tends to choke the pipe, and is a common source of trouble due entirely to careless work.

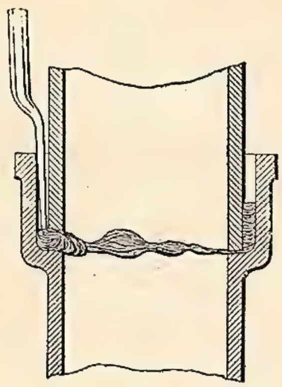

FIG. 14

15. The crooked joint shown in Fig. 15 is a common defect due to carelessness, and should be condemned on general principles. The work should be rearranged and a proper joint made; if the crooked joint is due to a defective fitting, a good one should be substituted. In a crooked joint, the oakum is liable to be driven through, as shown at *a*, and the lead is liable to run through, as at *b*, owing to the difficulty of introducing the oakum into the base of the socket.

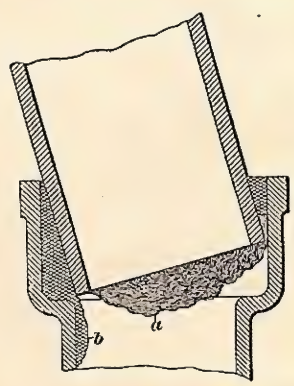

FIG. 15

16. Insertable Soil-Pipe Joint.—Plumbers often have occasion to cut a line of cast-iron soil pipe for the purpose

of inserting a branch. If ordinary fittings are used for this work, it is necessary for the plumber to melt or pick out two or three joints on the soil-pipe line so as to get the fitting in position in the manner shown in Fig. 16 (*a*). This method is often very inconvenient, and always tedious. To overcome the objections, the insertable joint shown in Fig. 16 (*b*) was designed. It is simply a short piece of pipe with an extra-long hub having a collar *a* cast inside, as shown. To insert this fitting, it is only necessary to cut out of the line a piece having a length equal to the sum of the lengths of the branch fitting and the insertable joint. The latter is then slipped over the end of the pipe, as shown at *b*, Fig. 16 (*c*). The branch *c* is next inserted, and the insertable joint is slipped back into the socket of the branch. This brings the collar *a* down near the end of the pipe *d*, but not below it, when the fitting *b* is sent home into *c*. The joints can then be calked in the ordinary manner. As shown, the branch is thus inserted without disturbing the rest of the soil-pipe line. A loose lead ring, shown at *e*, is sometimes slipped over the pipe before the insertable joint is applied, and is slipped down on top of the collar *a* before the oakum is calked into the joint. This is intended to positively prevent oakum from being driven down beyond the collar *a*, which collar may fit the soil-pipe line rather loosely.

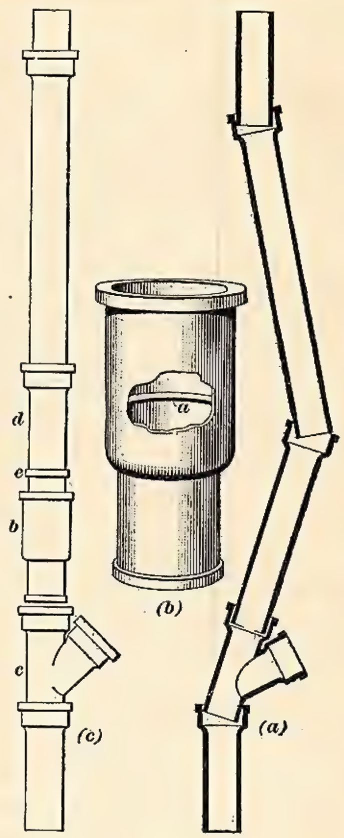

FIG. 16

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WROUGHT-IRON PIPEWORK

INTRODUCTION

17. Wrought-iron pipes form a considerable part of modern plumbing systems. For instance, water-supply pipes in many localities are chiefly galvanized wrought iron or steel. Drainage and ventilation pipes, also, are frequently of wrought iron. Hence, the plumber must be familiar with wrought-iron pipe work.

To facilitate the work, the pipe-fitter's bench must be made solid by braces or bolts. A flimsy bench or loose pipe vise prevents the fitter from doing good work, besides compelling him to exert considerably more energy than is otherwise necessary for cutting and threading pipes.

CUTTING PIPE

18. Wrought-iron pipe up to 2 inches in diameter is commonly cut by means of the ordinary wheel cutter. The pipe is placed in the vise, and the cutters are applied at the proper place. The wheels are then squeezed into the pipe little by little as the tool is revolved around the pipe, until the piece falls off. In applying three-wheel cutters, care must be taken to hold the tool square with the pipe; if this is not done, the wheel will cut several grooves instead of one, and if the wheels slip from one groove to another, their edges are likely to break. Single-wheel cutters are free from this liability, but do not cut the pipe as fast. Three-wheel cutters are particularly convenient for cutting pipes in close places where it is impossible to swing the tool entirely around the pipe. The cut ends should be examined to see whether any cracks or splits have been started by the cutting operation.

19. Pipes that are to be screwed into flush fittings, and there make butt joints, must have their ends squared either in a lathe or in a suitable cutting-off machine, after

they have been cut. Unless the end is perfectly square with the axis of the screw thread, it will be impossible to make a good joint against the shoulder of the fitting into which it is screwed.

20. When cutting pipe that is coated internally with enamel or glass, great care should be taken to avoid chipping or cracking the coating or lining. The wheel pipe cutter should never be used in cutting this kind of pipe The only kind of cutter that may properly be used is one that cuts like a lathe tool, leaving the end of the pipe square and true; if carefully used, it does not crack or peel off the brittle lining.

21. The larger sizes of wrought-iron pipe should be cut off either in a lathe or by a cutting-off machine. Oil should be used freely in cutting pipe, and the wheels of the cutter should be kept sharp, since, if their edges are dull, they will not wedge apart the metal forming the pipe, but will force a large part of it inwards, thereby reducing the bore of the pipe at this point by forming a large burr, as shown at *a* in Fig. 17, which will reduce the flow of water through it. Even if the wheels are kept perfectly sharp, a burr will be formed, but it will be much smaller than in the case of dull wheels. On all good work the burr should be removed.

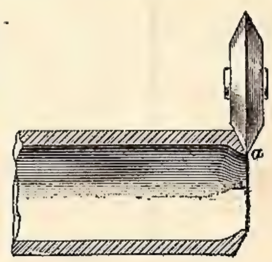

FIG. 17

REAMING

22. **Reaming** is the process of removing the burrs from the cut ends of pipes. The tools used for this purpose are called **reamers,** and are conical in shape; if properly proportioned, the length of the reamer, or the altitude of the cone, will be about twice the diameter of the base, as shown in Fig. 18, which represents a **hand reamer.** The convex surfaces of reamers are formed into a series of sharp teeth

converging toward the apex. By pressing the reamer into the orifice of the pipe and revolving it, the teeth cut off the burr and form the internal surface of the orifice into the

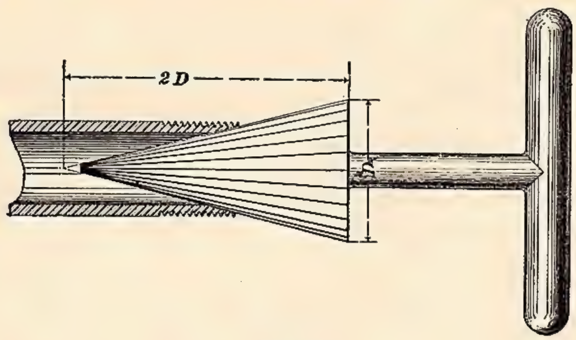

FIG. 18

frustum of a cone. There are reamers on the market for attaching to the stocks or dies so that the pipe may be reamed while the thread is being cut.

CUTTING THREADS

23. The tightness of a screwed joint depends largely on the accuracy with which the thread is cut. A good thread is shown in Fig. 19. The part *a* contains the **leading threads,** which are perfect in form. These are depended on chiefly for making a close contact with the thread in the fitting, and thus insuring a water-tight joint. The threads at *b* are imperfect. Their tops are flat and they only serve to make the joint rigid, unless their form be changed by the pressure exerted in screwing the pipe into a socket or fitting.

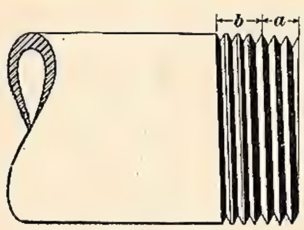

FIG. 19

24. Occasionally a groove runs lengthwise in a wrought-iron pipe; this prevents a perfect thread being made. Such pipes should not be used on high-pressure work. On low-pressure work, however, they may be used, provided that they

are screwed up with red-lead cement and hemp wrapped over the thread. These materials will fill the interstices, and usually make them water-tight.

25. When it is necessary to thread a piece of pipe that is too short to be held in the vise, a **nipple chuck,** or **nipple holder,** is used. This is simply a pipe coupling screwed over the end of a piece of pipe long enough to be held in the vise. The short piece, or nipple, should be screwed into the coupling until it butts against the end of the longer pipe, as this prevents swelling and splitting of the coupling. After a long nipple has been cut, it can be unscrewed with a pipe wrench; to remove a close nipple from the nipple chuck, the coupling should be unscrewed a little from the piece held in the pipe vise, when the nipple can be screwed out with the fingers. When close nipples are to be cut, the threaded end should enter the coupling a little less than the length of the perfect threads, and then butt against the piece held in the vise.

TABLE I

SCREW THREADS FOR WROUGHT-IRON PIPE

Nominal Internal Diameter in Inches	Number of Threads Per Inch	Length of Perfect Thread in Inches	Nominal Internal Diameter in Inches	Number of Threads Per Inch	Length of Perfect Thread in Inches
$\frac{1}{8}$	27	.19	2	$11\frac{1}{2}$	.58
$\frac{1}{4}$	18	.29	$2\frac{1}{2}$	8	.89
$\frac{3}{8}$	18	.30	3	8	.95
$\frac{1}{2}$	14	.39	$3\frac{1}{2}$	8	1.00
$\frac{3}{4}$	14	.40	4	8	1.05
1	$11\frac{1}{2}$	.51	$4\frac{1}{2}$	8	1.10
$1\frac{1}{4}$	$11\frac{1}{2}$	.54	5	8	1.16
$1\frac{1}{2}$	$11\frac{1}{2}$	.55	6	8	1.26

All pipe ends are made conical, the taper being $\frac{3}{4}$ inch of diameter per foot of length.

26. The majority of manufacturers of wrought-iron pipe have adopted the **Briggs standard** system of screw threads for pipe and fittings. A few manufacturers, however, do not conform to it strictly; they use 12 threads per inch instead of the $11\frac{1}{2}$ threads called for in the table.

To make perfect joints with standard fittings, the perfect threads should be cut to a certain distance only from the end of the pipe. This distance is stated in Table I.

SCREWING ON FITTINGS

27. In order to make sure of having a water-tight joint, it is customary to paint the perfect threads (seldom more than three or four) on the pipe and in the fitting with red-lead, or other, cement before entering the male thread. Because the thread is tapering, the pipe or the fitting starts easily and the cement stays where put. If the red lead is sparingly applied, little, if any, will show outside, or be pushed inside by the operation of screwing up. Care must be taken not to overload the female thread with red lead, and not to screw up fittings too tight, for they may split. The proper point to stop screwing up can only be determined by experience. In screwing on valves or other brass fittings, whether plain, finished, or nickel plated, the wrench should always be applied to the hexagon shoulder provided for the purpose. This will prevent the brass fitting from being distorted.

BENDING WROUGHT-IRON PIPE

28. Small sizes of pipe, such as 1-inch or less, are usually bent cold over a block or mandrel. Larger pipes, however, are heated to redness and then bent over a curved block, or better still, over an iron wheel having a groove to receive the pipe and prevent its sides spreading while being bent. The weld, or seam, of the pipe should always be kept on the inside of the curve, to prevent splitting the pipe. Only

black pipe should be bent. If galvanized pipe is bent cold, the zinc coating often breaks or chips off, and if bent hot, the zinc is vaporized by the heat and the protective coating thus spoiled.

MEASURING FOR PIPING

29. When taking **measurements for piping,** the center-to-center distances of the different pipe lines are measured first, and then allowance is made for the fittings. Fig. 20 (*a*) shows a sample of pipework composed of four

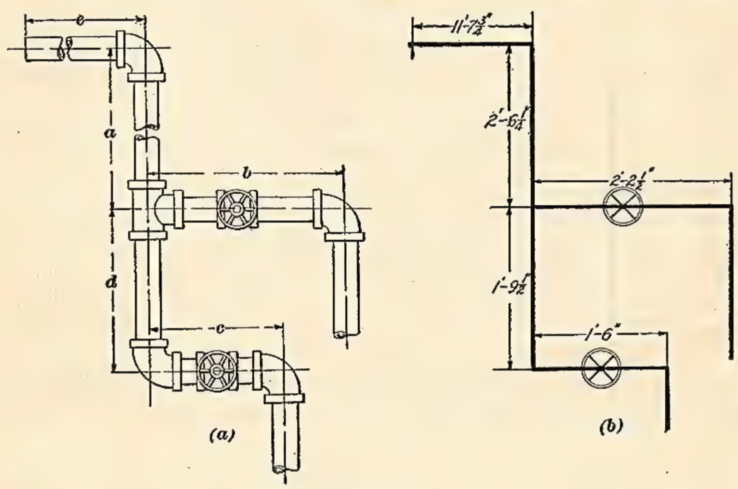

FIG. 20

elbows, one tee, two valves with wheel handles, and seven pieces of pipe. Where a valve is placed in a pipe, it is customary to consider the two pieces of pipe to which it is attached, and the valve, as one piece; this accounts for the statement that there are seven pieces of pipe. The dimensions marked *a*, *b*, *c*, *d*, and *e* are measured, and transferred for reference purposes to a sketch similar to that shown in Fig. 20 (*b*). In locating the valves, it is customary to use a ready-made nipple on one side, and then to cut a piece for the other side sufficiently long to obtain the proper length of *b* or *c* when the whole is screwed up.

30. In measuring for 45° fittings, the plumber must exercise considerable care. He may place the fittings in position and measure between them, using try pieces *a*, *a*, as shown in Fig. 21, which point straight toward each other, thus obtaining the measurement *b*, which will be the length of pipe required. In case, however, that it is inconvenient to do this, the exact measurement across at *c* may be taken, which if multiplied by 1.4142 will give the length of the diagonal line from center to center of the 45° fittings. From the length thus found must be subtracted the distances between the ends of the diagonal pipe and the center of the fittings.

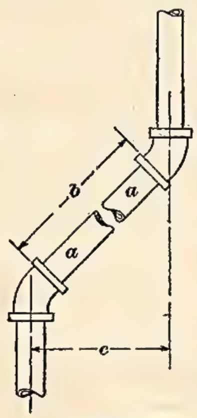

FIG. 21

EXAMPLE.—What length of pipe is required at *b*, Fig. 21, assuming that 1 inch is allowed between each end of the pipe and the centers of the fittings, and that the distance *c* is 4 feet 9 inches?

SOLUTION.— 4 ft. 9 in. $\times$ 1.4142 $-(1+1) = 57 \times 1.4142 - 2 = 78.6$ in., or 6 ft. $6\frac{1}{2}$ in., fully. Ans.

31. A simple method for finding the diagonal length is as follows: Strike two parallel chalk lines on the bench or

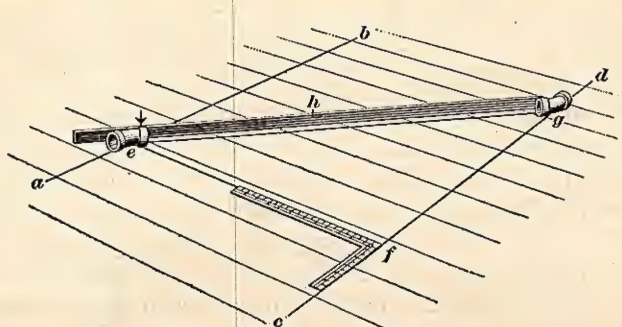

FIG. 22

floor to represent the center lines of the pipes to be joined by the diagonal piece, as *a b* and *c d*, Fig. 22. Lay a steel

square against one of these lines, as shown, and draw a perpendicular *e f*. From the intersection at *f* on *c d* lay off a point *g*, making *f g* equal to *e f*. Draw a line through *e* and *g*. Then lay a 45° fitting over each of these intersections and measure with a rod *h*, as shown, the length of pipe required.

BRASS, COPPER, AND EARTHENWARE PIPEWORK

BRASS AND COPPER PIPEWORK

HOLDING THE PIPES

32. Brass and copper pipes of iron-pipe size are handled the same as iron pipe, excepting that more care is exercised in preserving the surface of the pipe from being damaged by the jaws of the pipe vise or the pipe wrenches. While pipe tools used for gripping iron pipe have teeth that cut into the pipe, the tools used for brass or copper pipe should grip the pipe only by friction, so that the pipe will not be marked by the vise or the other tools.

33. Friction clamps made as shown in Fig. 23 are used for fixing a pipe in the pipe vise. The clamps *a* and *b* are made to fit the jaws of an ordinary vise, and the curve is formed to fit a standard size of pipe. The curve is lined with rubber or some other soft body. The pipe-vise jaws compress *a* and *b* and the pipe then cannot slip. The clamps are made long so as

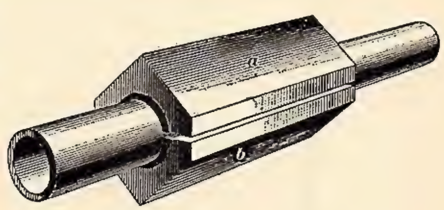

FIG. 23

to spread the pressure over a large area of pipe and thus prevent its flattening. Fig. 24 shows how a plumber can make his own friction clamps. A common iron-pipe coupling is sawed into equal parts *a* and *b*, and then lined with thick sheet-lead pieces *c*, *d*. They grip the pipe like *a* and *b*, in Fig. 23, but with heavy pressure from the pipe vise these clamps are liable to spread. Powdered rosin is usually sprinkled in these clamps to prevent the pipe slipping. This can be washed off the pipe with kerosene oil after the threads are cut. If the pipes are nickel plated, care must be taken to prevent their slipping in the clamps; otherwise ugly rings will be scratched around the pipe, which indicates careless workmanship.

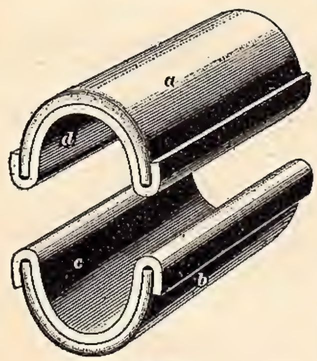

FIG. 24

THREADING BRASS AND COPPER PIPE

34. In **threading brass or copper pipe,** particular care should be taken to revolve the dies with a uniform motion. This prevents splitting the pipe, and allows the dies to cut slowly and evenly, which helps to prevent the thread from being ragged or chewed away in places. Particular care should be taken, in threading nickel-plated pipe, to make the threads just long enough to be all hid in the fitting, as shown at *a* in Fig. 25, instead of having them too long and allowing a few threads void of plating being visible, as at *b*. The former indicates neat, skilful workmanship.

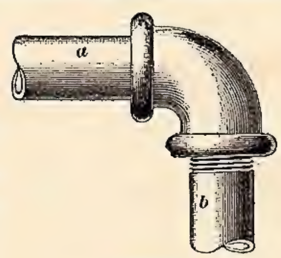

FIG. 25

The neat finish shown at *a*, Fig. 25, is readily obtained by the use of **recessed fittings,** which allow some of the

plain part of the pipe to slip into the socket, as shown at *a* in Fig. 26. The liability of having threads show when the fitting is screwed up is thus avoided.

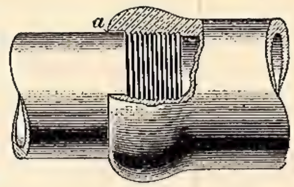

Fig. 26

35. Thin brass tubes, such as are commonly used for flush pipes, waste pipes under wash basins, etc., are cut with a hack saw, and then threaded with special dies having a larger number of threads (27 to the inch) than ordinary iron-pipe dies. Special **fine thread fittings** are used for such tubes.

36. In threading nickel-plated pipe, a wrapping cloth or paper should be placed between the guide and the pipe, in order that the guide will not mark the pipe as it revolves.

SCREWING UP FITTINGS

37. The best way of **screwing up** such fittings as elbows and tees, is to screw a short piece of pipe into the fitting and to use it as a lever. After the fitting is screwed home, the piece of pipe is removed. As brass fittings yield quite easily, owing to their comparative softness, there is a danger of seriously distorting them if they are screwed home by the aid of a pipe wrench or monkeywrench.

38. Fittings that are furnished with hexagon shoulders should be screwed up by applying a monkeywrench to the hexagon, placing a piece of cloth between the jaws of the wrench and the nickeled surface. A wrench with teeth should never be used for nickel-plated brass or copper work. The joints of brass and copper pipes are usually put together with red or white lead in the threads. When they are to be soldered, or **sweated,** as it is called, the threads should be tinned with half-and-half solder, and while hot screwed up tight before the solder has time to set. A torch flame is used for heating the work, which is tinned by rubbing it while hot with a strap of solder.

BENDING BRASS AND COPPER PIPE

39. Before attempting **to bend brass or copper pipe,** it should first be annealed, that is, made red hot, and then plunged into cold water. This softens the pipe and makes it easier to bend. Common water pipes (iron-pipe size) having diameters less than 1 inch are bent cold over a grooved block, in the same manner as iron pipe. Larger sizes, however, after annealing are filled with melted rosin and then bent over a form when cold. The rosin having solidified in the pipe, prevents its collapsing while being bent. After the proper shape is obtained the pipe is again heated to melt the rosin, which is allowed to run out. Sometimes the pipes are filled with melted lead, while some people use sand for filling the pipe.

40. Nickel-plated pipes should not be bent after they are plated. They should first be bent to suit their respective positions and then nickel plated, since nickel plating usually cracks at the bends when an attempt is made to bend nickel-plated pipe. In bending brazed tubing, the seam should always be on the inside of the bend, because it is more brittle than the other parts, and being weaker, it may open out if placed anywhere else.

EARTHENWARE PIPEWORK

LOCATION AND CUTTING PIPE

41. Earthenware pipes should never be used inside of or under buildings; in fact, all plumbing ordinances prohibit their use in such places. They should only be used for underground work outdoors, and then only in ground that will not settle. Made ground, that is, ground made by filling in with ashes and earth, is sure to settle, and in doing so, break the pipes.

42. To cut earthenware pipe, lay it on a mound of soft earth and then cut a groove all around the pipe with a sharp cold chisel and a light hammer.

MAKING JOINTS

43. To make good joints in earthenware pipes, place some cement (half Portland cement and half clean sand) in the bottom of the socket, as shown in Fig. 27. Then enter the spigot end of the pipe about to be laid into the socket, as shown in Fig. 28. When the spigot end is pushed hard against the socket shoulder at *a*, let it down on the cement. Beat it down gently with a wooden tool, the hammer handle, for instance, until it is in the center of the socket. This presses the superfluous cement out of the socket and insures the bottom, which is the most important part of such a joint, being tight. The entire joint should then be carefully cemented water-tight. When this is done, a wooden scraper is pushed inside the pipe, and any cement that may have worked inside is scraped out, as shown in Fig. 29. This figure shows a well-made joint that will be perfect after the loose cement *a* is removed.

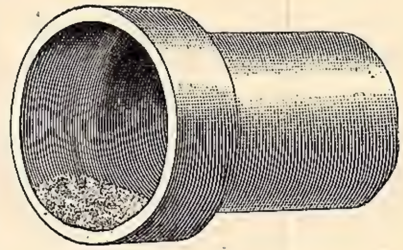

FIG. 27

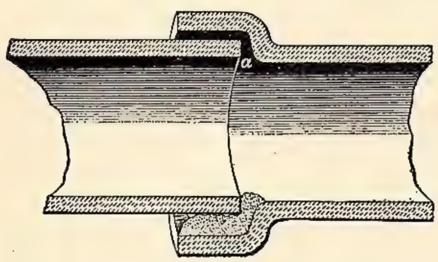

FIG. 28

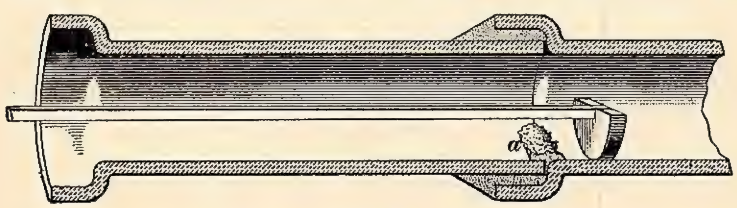

FIG. 29

44. Fig. 30 shows a very common defective joint, where cement projects on the inside, as at *a*. This defect generally occurs when a whole line of pipes is first laid in a trench and then jointed. The proper method is to cement and finish each length of pipe as soon as laid. If joints

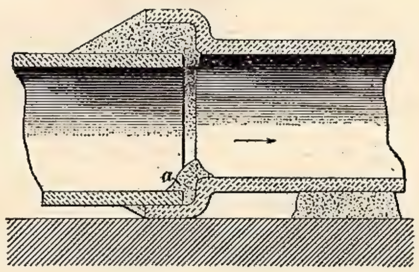

FIG. 30

must be cemented after the entire line of pipes is laid, it is advisable to calk two strands of oakum into the socket before the cement is applied. This will prevent the cement from running into the pipe. It will also help to center the spigot in the socket.

TABLE II

SPACING FOR TACKS

Size of Pipe in Inches	Distance Apart in Inches			
	Vertical Pipe		Horizontal Pipe	
	Hot	Cold	Hot	Cold
$\frac{3}{8}$	18	24	12	16
$\frac{1}{2}$	19	25	14	17
$\frac{5}{8}$	20	26	15	18
$\frac{3}{4}$	21	27	16	19
1	22	28	17	20
$1\frac{1}{4}$	23	29	18	21
$1\frac{1}{2}$	24	30	18	22

PIPE SUPPORTS

SUPPORTING LEAD PIPES

TACKS, BANDS, COLLARS, AND LEDGES

45. Lead pipes 2 inches in diameter and less, which run against walls, etc., are usually supported by means of flanges, or **pipe tacks,** which are soldered on to the pipe at convenient intervals, and are fastened to the walls with common wood screws, as illustrated in Fig. 31, which shows a $\frac{3}{4}$-inch lead pipe *a* secured to a wall or pipe board *b* by molded pipe tacks *c*, *c* and 1-inch wood screws *d*, *d*, etc. The tacks are made of old lead, slightly hardened with a few old wiped joints mixed in. They are cast in brass molds and can be bought from dealers of plumbing material.

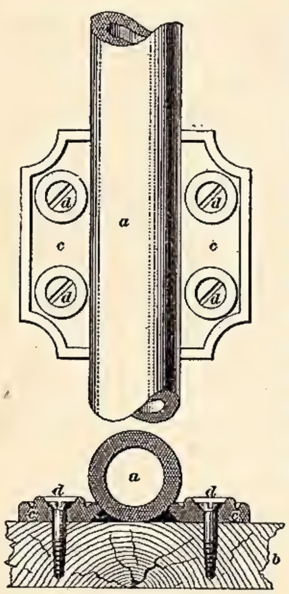

FIG. 31

The approximate spacing for tacks on lead pipes is given in Table II.

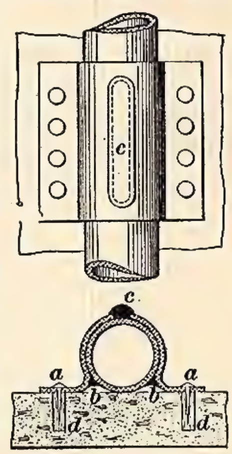

FIG. 32

46. Pipes over 2 inches in diameter are best supported by means of broad **bands,** such as are shown in Fig. 32, which are attached at intervals of about 3 or 4 feet. The width of the bands, along the line of the pipes, measured for pipes of 2, 3, or 4 inches diameter, should be about 6, 8, or 10 inches, respectively. An oblong hole *c* is cut in the front

of the band and is filled with hot solder and wiped to the face of the pipe. The side flanges of the band are wiped to the face of the pipe, as shown at *b*. The band is shown secured to a stone wall by flathead spikes *a*, driven into wooden plugs *d*, which have been previously driven into holes cut in the stonework.

47. Vertical pipes of lead are usually supported, where they pass through floors, by means of a flange, or **collar,** which is wiped to the pipe; or a flange joint is made at that point. The diameter of the flange should be about 2 inches larger than that of the pipe, to give room for wiping.

48. When a hot-water pipe runs horizontally, it is best to support it upon a continuous **ledge,** or shelf. It should have room enough laterally to bend and creep, and should be kept from working off the shelf by a suitable rim or flange along the edge of the shelf.

49. Lead pipes should not be supported by iron wall hooks or similar supports, unless they are protected by an extra thickness of sheet lead between them and the iron, because the edges of the iron will gradually cut into the lead and thus weaken the pipe.

INFLUENCE OF TEMPERATURE

50. If the temperature of a lead pipe that is supported by rigid fastenings is maintained nearly uniform, as in the case of the cold-water supply pipes, the pipe can only be changed in form by its own weight, the jarring of the building, etc.

If, however, the temperature of the pipe is variable, as in the case of the pipes that supply hot water to the plumbing fixtures, the pipes will expand as the temperature increases, which causes them to bulge between their supports. If the pipes are vertical, they will bulge either from the wall against which they are secured or parallel to it. If they are horizontal or inclined, they will always bulge downwards and form pockets or sags. Lead is so very low in elasticity that when the pipe becomes cool, the sags are not entirely taken up by contraction, and upon every application of heat

the sags will increase in size, particularly on horizontal pipes, until the lead becomes so thin near the points of support as to cause a leak. The leak generally occurs in a crack that is formed around that part of the pipe near the tacks.

Suppose that a lead waste pipe 2 inches in diameter, secured in a vertical position against a wall by hard metal tacks or lead bands, has a kink in it, and that hot water passes through the pipe periodically. It will be found that since the kink is the weakest part of the pipe, it will take up most of the expansion between the tacks on each side of it. This action subjects the kink to a cross-strain, repetitions of which will soon overcome the cohesive strength of the lead and cause the metal at that point to crack. Kinks should be carefully avoided in all lead pipework. A kink in a lead waste pipe is a positive sign of slovenly, careless, or ignorant workmanship, and should not be tolerated.

SUPPORTING IRON AND BRASS PIPES

IRON AND BRASS PIPE SUPPORTS

51. Wrought-iron pipes may be fastened in place by common drive hooks, but where a good appearance is desired, they should be fastened with bands, which are secured to the walls by screws, as shown in Fig. 33. The band, or strap, *a* should be made of wrought iron tinned.

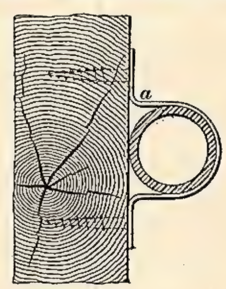

FIG. 33

Brass pipe may be similarly supported, making the bands of brass. It is usually supported, however, by specially made clamps or pipe hangers, which are first attached to the walls, the pipe being afterwards laid in them and locked there by closing the outer half of the clamp, which is hinged to the main body. Such supports usually hold the pipe at a little distance from the walls; this prevents vermin from lodging around it, and also allows it to be polished conveniently.

SUPPORTING CAST-IRON PIPES

52. Cast-iron soil and vent pipes should be strongly secured in place. Vertical stacks should rest on a solid support at the bottom. If an elbow occurs at the base of the stack, it should be provided with a flat foot, or **heel rest,** as shown at *a* in Fig. 34.

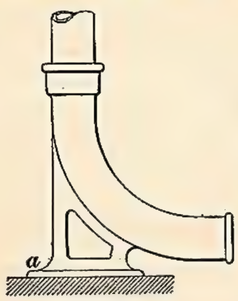

FIG. 34

The weight of the pipe should be borne entirely by the base support. The pipe should be held in place by means of hooks or bands, which are placed at intervals of 5 feet or less, according to the nature of the work.

53. The pipe may also be secured against the face of a stone wall by means of a wrought-iron band *a*, as shown in Fig. 35. Two holes *b*, *b* are cut in the stone, and the ends of the band are calked in the holes with lead. This style of fastening is neat and reliable.

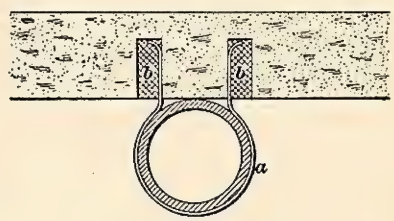

FIG. 35

All hooks or bands should clasp the pipe close under the hub, or around it, and should not be placed midway between the joints, if it is possible to avoid it.

54. If the pipes stand in a chase, or groove, in the wall, they may be fastened by means of clamps, or **pipe rests,** *a*, which are secured in notches *b*, *b* cut in the wall, as shown in Fig. 36.

Care must be taken that the fastenings are so arranged that the pipe will be free to contract and expand with the changes of temperature without loosening itself, or tearing the fastenings loose from the walls. Buildings are always liable to settle, and this must be kept in mind when locating the pipe fastenings.

Iron drain pipes that run inside of basements or cellars should be thoroughly supported by wrought-iron straps fastened to the beams overhead, or else they should be supported at short intervals on brick piers or iron standards, or by wall hooks driven into the brick or stone walls.

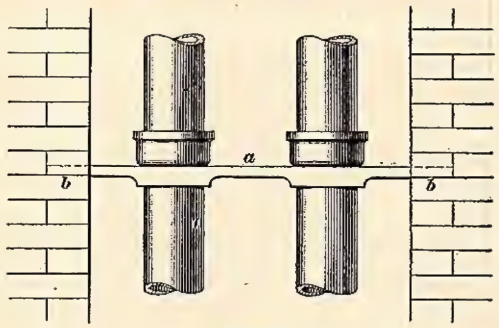

FIG. 36

A substantial pier should always be placed under each stack. In all cases a firm support, such as a brick pier or iron corbel, should be placed under the junction of the stack with the inclined drain pipe. All stacks should be supported independently of the main drain, so as to relieve the inclined pipe of the weight of the stack.

FASTENING DEVICES FOR STONEWORK

55. In pipework, as well as in other work connected with plumbing, it often occurs that pipe hangers and other apparatus are to be fastened to stonework by means of bolts, or rods are to be fastened to stonework for various purposes.

A hole about $\frac{1}{2}$ inch larger than the rod is first cut or drilled in the stone to a suitable depth, which will vary with the nature of the work, a common depth being from 4 to 6 inches. The end of the rod is notched or roughened in some way; it is then inserted in the hole, and the space around it is filled with a suitable cement, such as melted sulphur. If the connection is exposed to the weather, the exposed part of the iron should be coated with asphaltum or other waterproof compound.

The rod may also be secured by filling up the hole with molten lead and finishing by calking the lead. Care must be taken in calking to avoid splitting the stone. The junction of the lead and iron generates a chemical action that corrodes the iron and gradually eats it away. This may be prevented by coating the exposed part of the iron with asphaltum.

56. Bolts may be secured to marble or slate slabs by the method shown in Fig. 37.

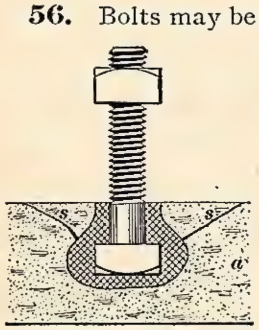

FIG. 37

A hole is drilled in a slab *a* to the required depth, and is enlarged at the inner end, as shown, by means of suitable chisels. After the bolt is placed in the hole, molten lead is poured around the bolt. The lead is then gently calked. If the lead is calked too much, the marble will break away, as shown by the lines *s*. Plaster of Paris is also used to fill the space around the bolt in cases where but little strain is likely to be put on it.

57. Attachments may be made to stonework by means of expansion bolts, as shown in Fig. 38. These bolts are provided with a loose ring *a*, having its lower edge beveled, and a notched ring *b* of soft metal. A hole is drilled in the stone large enough in diameter to fit the bolt closely, and the bolt is pushed in to the depth required. The nut *c* is then screwed down and the ring *a* is forced into the end of the soft ring *b*, which is thereby expanded against the sides of the hole. These bolts are less liable to split the stones than those that are calked with lead, because the directions of the forces exerted in securing this bolt are mainly in directions parallel with the surface of the slab and in the middle of its thickness, as shown by the arrows.

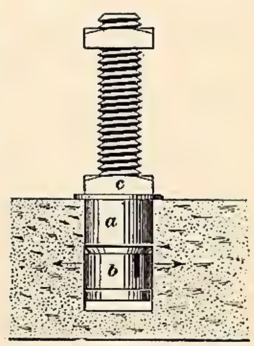

FIG. 38

PIPEWORK

EXAMINATION QUESTIONS

(1) Briefly describe the operation of cutting extra-heavy cast-iron pipe.

(2) In making calked joints in cast-iron pipe, what are the chief points to be considered ?

(3) In calking lead joints, at what point is it advisable to begin ? Give reasons.

(4) If, while calking a joint, you should discover that the hub is split, what would you do ?

(5) How are horizontal joints, or joints in an inclined pipe, made ?

(6) In order to make proper connections to a stack, it is found necessary to make an inverted joint. Describe how it should be done.

(7) It is found necessary to insert a **Y** branch in a line of 4-inch soil pipe. The pipe is in a vertical position on the face of a stone wall, and the joints are all calked. Describe how you would proceed.

(8) What kind of pipe cutter is best adapted for cutting pipes with enamel or glass lining ? Give your reasons.

(9) Why should the burr be removed from the cut end of a wrought-iron pipe ? Name and describe the method and tool used in this operation.

(10) On what does the tightness of a screwed joint largely depend ?

(11) Briefly describe how wrought-iron pipes of large diameter are bent.

(12) Briefly describe how measurements for piping are taken.

(13) What length of pipe is required for an offset of 5 feet at an angle of 45°, allowing $\frac{3}{4}$ inch on each end of the pipe for the fittings ? Ans. 7 ft., nearly

(14) Briefly describe the use of friction clamps and state what kind of pipe they are used for.

(15) (*a*) Explain what precautions are necessary in threading brass and copper pipes to insure a good thread. (*b*) State how screw joints can be made so that no threads will be exposed when screwed up.

(16) What precautions should be taken in cutting threads on nickel-plated pipe to prevent the guides from marking the pipe ?

(17) Describe how you would screw up nickel-plated brass fittings with hexagon shoulders, assuming that sweated screw joints are required.

(18) Explain how 2-inch brass and copper pipes are annealed and bent.

(19) Suppose you had a job to do where a large amount of bent nickel-plated pipes is required. Would you buy straight nickel-plated pipe and bend it to suit ?

(20) Explain the use of a wooden scraper in making cement joints on earthenware drain pipes.

(21) Suppose that you have to run a line of $\frac{3}{4}$-inch lead pipe for cold water on the face of a pipe board. What is the greatest distance apart you would place the pipe tacks ?

(22) What is the best way to support a lead hot-water pipe that runs horizontally ? Give your reasons.

(23) Describe a heel rest at the base of a soil stack and explain its use.

(24) Briefly describe how a rod or pipe can be inserted in and secured to a stone.

(25) How are ordinary brass bolts secured in marble slabs?

(26) Explain the advantage of an expansion bolt over an ordinary bolt that is calked in, for use in marble slabs.

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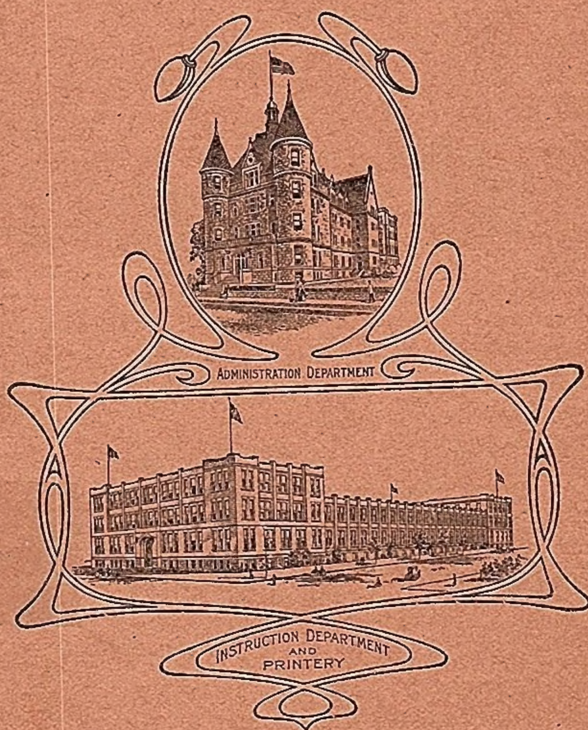
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